

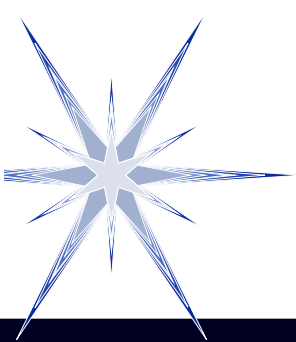
# **The Distributed Mission Training Integrated Threat Environment Project**

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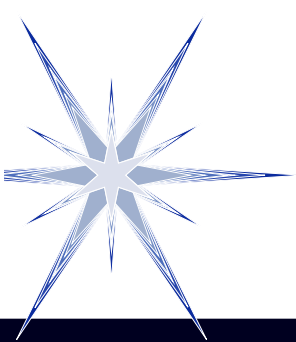
***mstytz, sbanks@aft.afmil***



# The Vision

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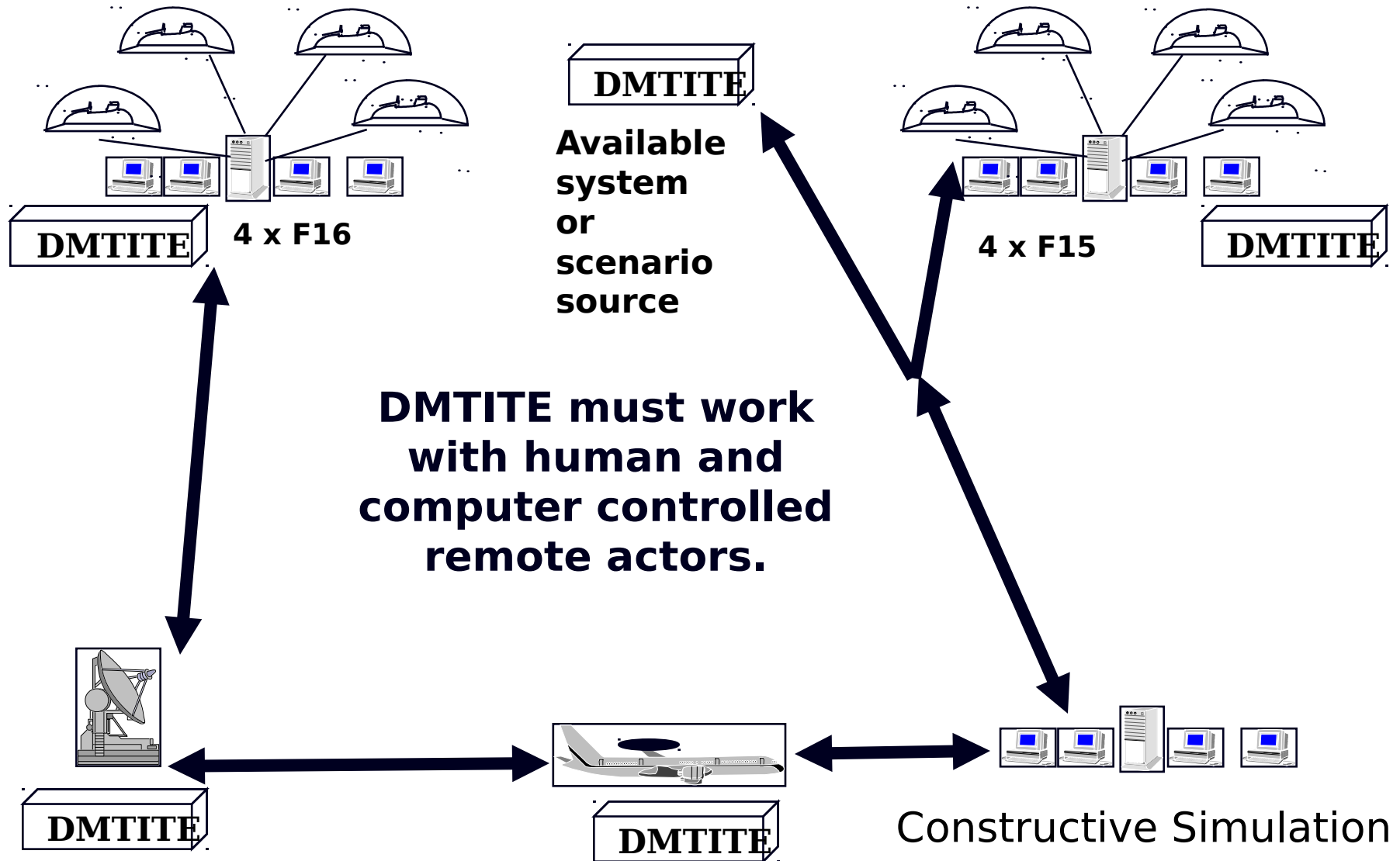
- **Move training from real to virtual world**
  - Cost
  - ▢ Safety
  - ▢ Accessibility
  - ▢ Frequency
  - ▢ Comprehensive
- ▢ **Joint synthetic battlespace**
  - ▢ Military operations are joint

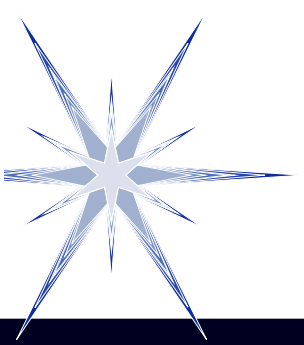


# Introduction

- **AF needs distributed mission training (DMT)**
- **A key DMT element is computer-generated threats (CGTs) composed of computer-generated actors**
- **Consistent, interoperable, coordinated and modifiable DMT threats are not available**
  - Lack skills and accurate behaviors
  - Closed threat systems
  - Threat coordination difficult

# The DMT Operational Concept

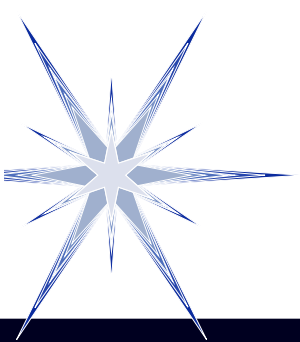




# **Current CGA Deficiencies**

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- **Scripted behaviors**
- ▢ **Domain-specific CGF engineering**
- ▢ **Appropriate and realistic behaviors**
- ▢ **Skill levels within a CGF type**
- ▢ **Domain independent architecture**
- ▢ **Extensible knowledge representation**
- ▢ **Capability for knowledge modification**



# Distributed Mission Training Integrated Threat Environment

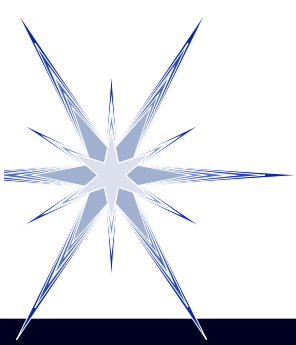
## □ What is DMTITE?

### ➤ A comprehensive threat system

- Aircraft, radars, jammers. missiles, rockets, UAVs, IADS, etc.

### □ Research

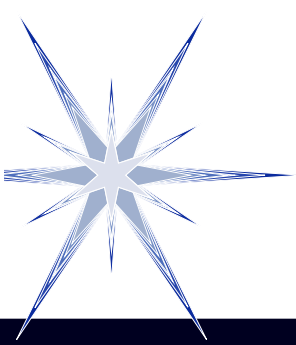
- Human behavior modeling
- Extensible, open software architecture
- Multiple platforms
- Fidelity & skill levels
- Coordinated behaviors
- Team/group behaviors



# **DMTITE Project Issues**

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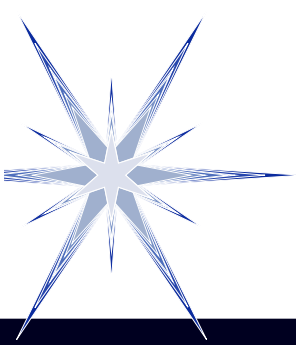
- **Performance requirements and specifications**
- ▮ **System architecture and internal data transport**
- ▮ **Terrain model**
- ▮ **Sensor systems with correlated databases**
- ▮ **Decision system, learning capability, and knowledge base**
- ▮ **Knowledge acquisition and representation**
- ▮ **Behavior modeling**
- ▮ **Coordination between DMTITE systems**
- ▮ **Skill levels and fidelity levels**
- ▮ **HLA**



# Baseline DMTITE Requirements

- ▮ **Information fidelity**
- ▮ **Modifiability**
  - ▮ Knowledge base & flexible software architecture
- ▮ **Variety of threat systems**
  - ▮ Air, ground, jamming
- ▮ **Variable levels of fidelity**
  - ▮ World, dynamics, sensors, human behavior
- ▮ **Adaptable decision mechanisms**
- ▮ **Threats at varying levels of skill**
- ▮ **HLA**

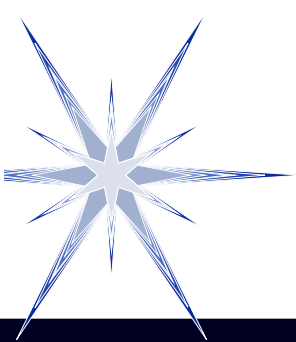




# Strategy

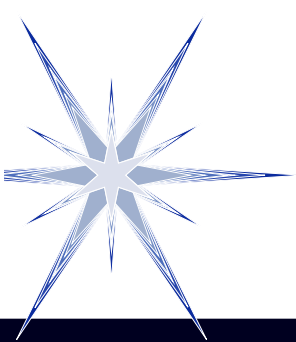
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- **Develop the technical infrastructure first**
- **Modern development techniques**
- **Software architecture first**
- **Test and evaluate each technical approach as developed**
  - Simple so can evaluate
- **Refine approach based on results of test**

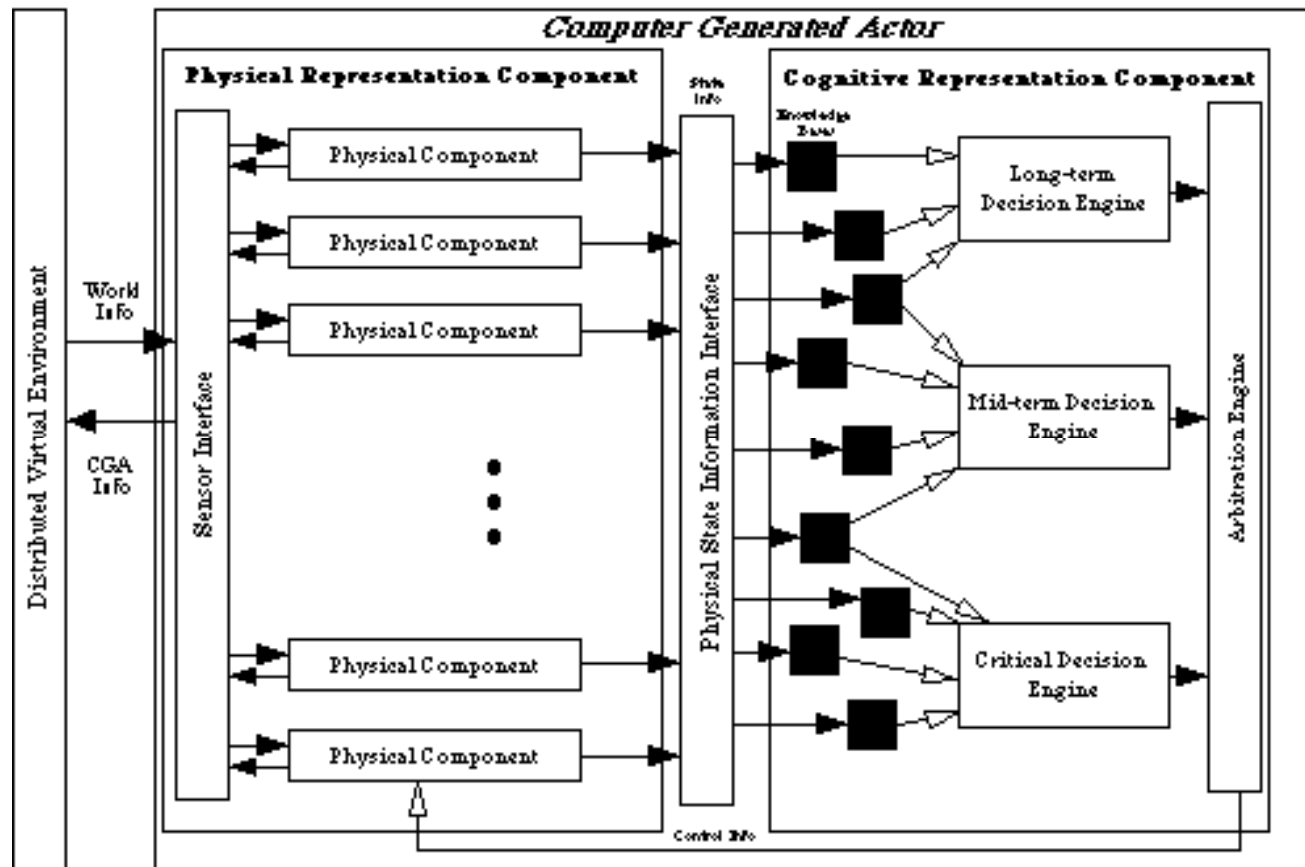


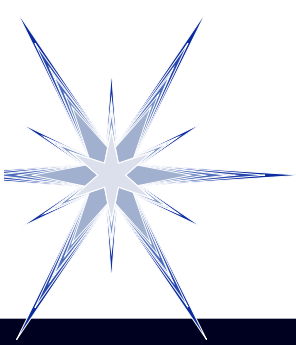
# System Architecture

- **Isolation of changes**
- **Minimize data transport cost**
- ▢ **Software Architecture**
  - Cognitive Representation Component
  - ▢ Threat Knowledge Base Component
  - ▢ Physical Representation Component
- ▢ **Intelligence architecture**
  - ▢ Structure, modifiability, efficiency, content, skills, fidelity
  - ▢ Manage uncertainty and missing information
  - ▢ Accurate portrayal of threat doctrine and tactics
  - ▢ Multiple engines
- ▢ **Knowledge base architecture**
  - ▢ Skills, fidelity, granularity of knowledge, behavior model
  - ▢ Multiple skill & fidelity levels



# DMTITE Architecture

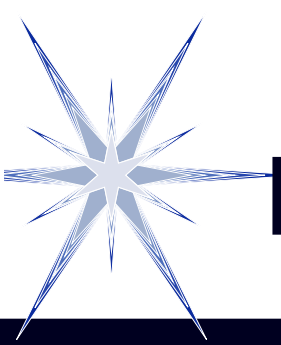




# The DMTITE Decision Engines

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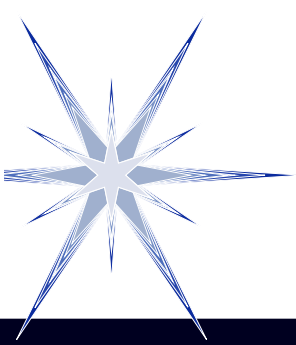
- **Long-Term Decision Engine (LTDE)**
  - Mission goals, on-board planning
- ▢ **Mid-Term Decision Engine (MTDE)**
  - ▢ Near term objectives, responds to SDE direction
- ▢ **Critical Decision Engine (CDE)**
  - ▢ Short-term emergency situations, reactive system
- ▢ **Arbitration Engine (AE)**
  - ▢ Refine LTDE, MTDE, and CDE control outputs
  - ▢ Incorporate skills



# Knowledge-Centric Design

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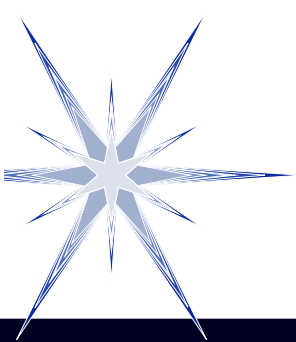
- ▶ **Acquire cognitive representation knowledge**
- **Acquire physical representation knowledge**
- **Two part CGF design methodology**
- **Design Methodology: Part 1**
  - ▶ Determine knowledge required by CGF category
  - Time consuming, but done fully only once
- **Design Methodology: Part 2**
  - How CGF knowledge is invoked
  - Likely performed for each CGF instantiation



# CGF Multiple Skill Levels (1)

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- ▶ **The Entity Profile**
  - Skills vector
    - ▶ Ability to perform a task
  - Entity traits
    - Predisposition to type of reaction
  - Combat Psychology Model
- **Allows individualized CGF behaviors**



# CGF Multiple Skill Levels (2)

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## ► The Entity Profile

- ▢ Skills vector

  - Hierarchy of parameters that may change over time

  - ▢ Highly specialized skills mapped to more basic skills

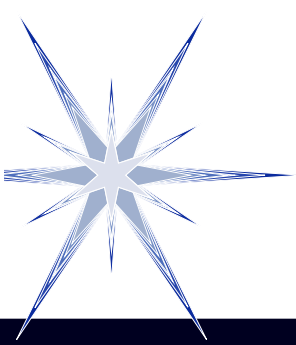
- ▢ Entity traits

  - ▢ Apply to all CGFs

  - ▢ Factor in genetics and life experience

- ▢ Combat Psychology Model

  - ▢ Used in conjunction with entity traits



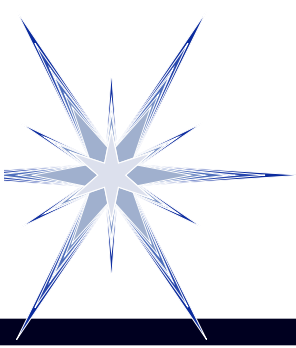
# CGF Multiple Skill Levels (3)

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## ► **Combat Skills Model**

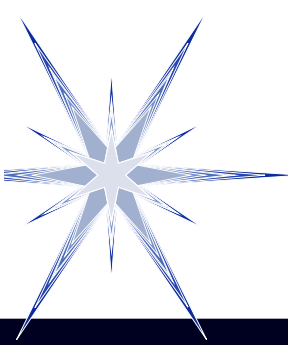
- Utilized within the Arbitration Engine
- Refines decision engine outputs
- Provides means to incorporate
  - Aggressiveness
    - Ability/Ability to apply knowledge
    - Capability to anticipate enemy maneuvers
    - Promptness to obey orders
    - Morale
    - Anxiety
    - Visual acuity





# Knowledge Representation

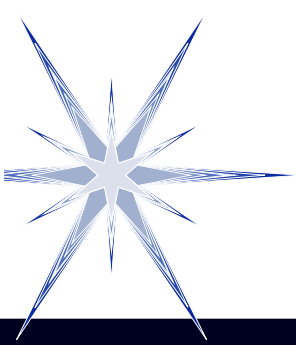
- **Single representation to support multiple inferencing strategies**
  - Minimize duplicate knowledge, centralize
- **Knowledge represented by if-then predicates**
  - Directly supports inferencing by case-based, rule-based, indirectly supports fuzzy logic
- **Treat skills as knowledge modifiers**



# **Project Accomplishments**

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- **CGA Software Architecture - open, extensible**
- ▢ **Isolation of changes - entropy**
- ▢ **CGA Knowledge Architecture**
- ▢ **Multiple skill levels**
- ▢ **Human behavior & combat psychology**
- ▢ **Knowledge acquisition methodology**
- ▢ **High & multiple fidelity**
- ▢ **Sensor & dynamics modeling**



# Conclusions

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- ▮ **Required to meet AF training needs**
  - ▮ Flexibility, interoperability & maintainability
  - ▮ Independent of simulator systems
- ▮ **Viable approach**
- ▮ **Unique**
- ▮ **Prototype development underway**